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ATTENDANCE AT THE GRADUATE SCHOOL OF  
HARVARD UNIVERSITY

To THE EDITOR OF SCIENCE: Permit me to call the attention of your readers to a mis-statement that appeared in the issue of December 24, 1909, to the effect that the attendance on the graduate school of Harvard University showed a loss as compared with the previous year. The error arose from the fact that in the figures for 1908 the graduate students at Radcliffe were included under Graduate Schools, whereas they were omitted in 1909 under the caption of graduate faculties, but included under women undergraduates. On November 1, 1908, there were 450 students at Radcliffe, of whom 394 were undergraduates and 56 graduates. Adding the latter to the enrollment in the Graduate School of Arts and Sciences gave a total of 460. On November 1, 1909, there were 464 students at Radcliffe, of whom 402 were undergraduates and 62 graduates. Adding the latter to the enrollment in the Graduate School gives a total of 485, representing an increase of 25 over the figures of 1908. This year's attendance on the Graduate School of Arts and Sciences is the largest in the history of the institution.

RUDOLF TOMBO, JR.

COLUMBIA UNIVERSITY

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SCIENTIFIC BOOKS

*Encyclopédie des Sciences Mathématiques pures et appliquées*, publiée sous les auspices des Académies des Sciences de Gottingue, de Leipzig, de Munich et de Vienne, avec la collaboration de nombreux savants. Édition française, rédigée et publiée d'après l'édition allemande sous la direction de JULES MOLK. Tome I., volume I., Arithmétique. Paris, Gauthier-Villars; Leipzig, B. G. Teubner. 1904.

It is customary to await the completion of a work before writing a review of it, but unusual conditions frequently call for unusual action. The greatness of the work before us and its wide range of contact with subjects familiar to all educated people seem to justify a brief review at this stage of its development; especially since such a review may be of serv-

ice to many who wish to take advantage of the various parts of the work as soon as possible, and since a large amount of work remains to be done before this first volume can be completed, although more than 600 pages of it have been published.

The German work upon which this French edition is based is the work of scholars of many different nations, so that the present work is decidedly international and it is appropriately issued by the two leading mathematical publishers in the world. The object of the German edition is to give as completely as possible the fully established mathematical *results* and to exhibit, by means of careful references, the historical development of mathematical *methods* since the beginning of the nineteenth century. The work is not restricted to the so-called pure mathematics, but it includes applications to mechanics, physics, astronomy, geodesy and the various technical subjects, so as to exhibit *in toto* the position occupied by mathematics in the present state of our civilization.

The French edition aims to retain the essential traits of the German, but it is not merely a translation with the addition of more recent references. On the contrary, it takes account of the French traditions and habits as regards lucid exposition and it treats many subjects very much more extensively than the German edition, while other subjects receive practically the same treatment in the two editions. Both editions are issued in parts—the first parts of the German edition were published in 1898, while those of the French began to appear six years later. The German edition has the advantage of much greater progress towards completion, while the French has a decided advantage as regards exhaustive treatment and more recent references, although these advantages are partly offset by the fact that the additions make the work more voluminous and hence less convenient as a work of reference.

Notwithstanding the fact that the Germans have acted as pioneers in this vast undertaking and have partially prepared the way for the French, yet the latter have had no easy task before them, and in some cases they have done

so much more than their predecessors that the work appears almost new. To what extent this is true as regards the volume before us may be inferred from the number of pages which the French and German editions respectively devote to the various subjects considered in the published parts of this volume. The subjects and numbers of pages in the two editions are as follows, the first number applying to the French edition: Fundamental principles of arithmetic 62, 27; Combinatory analysis and determinants 70, 19; Irrational numbers and convergence of infinite processes with real numbers, 196, 100; Ordinary and higher complex numbers 140, 37; Infinite algorithms with complex numbers 20, 8; Theory of sets 42, 24; Finite discrete groups 85, 19. Hence the total number of pages devoted to arithmetic in the published parts of the French edition is 615, while the German edition devotes only 234 pages in all to this fundamental subject. The article on finite groups is the only one which is avowedly left unfinished in the parts of the French edition already issued, but additions to other articles are also to be made before volume I. is completed.

The list of subjects enumerated in the preceding paragraph constitutes *arithmetic*, the mother queen of mathematics, according to the best mathematical encyclopedia; and this list should be of interest to every educated person as indicative of what are regarded to be the most fundamental mathematical subjects by such an eminent tribunal. As the term arithmetic is now generally employed by mathematicians to include the most basal subjects of pure mathematics, and is not restricted to things which deal directly with numbers, it is of great interest to compare the classifications by eminent authorities and to observe that such new subjects as the theory of sets and the theory of discrete groups of finite order are accorded a place among these basal sciences. It is also of interest to observe that the latter of these subjects is accorded relatively the largest increase of space in this first volume of the French edition as compared with the German. This is partly due to the fact that the literature of this theory has

grown very rapidly during the last decade, and partly to the fact that this subject was given a disproportionately small amount of space in the German edition.

It is to be hoped that the present work will have a large circulation in this country, as it will doubtless be a standard for many years. Even those who have only a slight knowledge of the French language will be able to use it to great advantage, as the mathematical notation is practically cosmopolitan. The historical notes and references are especially complete and many of those relating to elementary arithmetic are of interest to teachers of this subject in the secondary schools. It is scarcely necessary to call the attention of the professors of mathematics in our colleges and universities to this work, since most of them have learned to appreciate the German edition and can not fail to appreciate still more an edition offering so many important improvements. While the specialist does not always know everything relating to his subject, it will probably be considered as almost unpardonable if any scholar displays ignorance of what this encyclopedia contains along the line of his chief interest.

Fortunately the volumes are sold separately so that those who may not wish to subscribe for the entire work can procure those volumes in which they may be chiefly interested. The remaining part of volume I. as well as the remaining parts of the other three volumes of Tome I. are, to a large extent, in press and will probably be published within a few years. The second and third of these volumes are devoted respectively to algebra and to the theory of numbers, while the fourth is devoted to the calculus of probability, theory of errors and diverse applications. In addition to the remainder of the article on finite groups, the volume under review is to contain the following: Complements on all the articles in the volume, bibliographical lists of the principal works treated in these articles, lists of the principal technical terms in the four languages, English, French, German and Italian, and the usual subject and author indexes together with a preface and an introduction.

The four parts of this volume which have appeared bear the following dates, respectively: August, 1904, May, 1907, April, 1908, and August, 1909.

The complete encyclopedia is to appear in seven tomes, each consisting of several volumes, probably ranging from three to five. The first three tomes are to be devoted to pure mathematics, while the following three are to treat the applications of mathematics. The seventh and last tome is to be devoted to historic, philosophic and didactic questions. As a large number of eminent French mathematicians are engaged on the preparation of this edition, its completion within a reasonable number of years seems to be assured and the high standard set by the dozen parts which have already appeared, although they are not free from serious errors, promises to be maintained in the future issues. If this is done the work will be indispensable, not only in the larger scientific libraries, but it will also be one of the most frequently consulted works in many private mathematical libraries. Those who do not have easy access to a large library will frequently find in this work sufficient references to guide them safely in their investigations. It is to be hoped that in this way it will serve as a powerful stimulus to mathematical progress in the highest and widest sense.

G. A. MILLER

UNIVERSITY OF ILLINOIS

*Crystalline Structure and Chemical Constitution.* By A. E. H. TUTTON, D.Sc., M.A. (Oxon.), F.R.S., A.R.C.S. (Lond.), Vice-president of the Mineralogical Society; Member of the Councils of the Chemical Society and of the British Association for the Advancement of Science. Cloth, 6 X 9, pp. viii + 200, figures 54. London, Macmillan and Co., Limited, 1910. \$1.50 net.

This interesting volume presents in condensed and connected form the results of a series of investigations in physical crystallography carried out by the author during a period of some twenty years, having for its object the establishment upon the most accu-

rate observational data of the exact relations existing between the chemical constitution and the crystalline form and properties of a series of related compounds.

These investigations consisted of three related parts: namely, the devising of new instruments capable of making more accurate observations than had hitherto been possible in this field; the perfection of methods of preparing crystals for investigation, and the actual measurements of the crystal angles and other constants.

The instruments devised, the description of which occupy chapters V., VI., VII., VIII. and IX., include a *cutting and grinding goniometer* so arranged that the small and soft artificial crystals employed could be cut and polished with absolute control of the direction of the artificial surface; the *spectroscopic monochromatic illuminator* to secure for the optical measurements monochromatic light of any desired wave-length; the *interferometer*, an instrument for fine measurements of length by the interference method, employed by Tutton as the essential optical part of the *dilatometer* for measuring the thermal expansion of crystals and of the *elastometer* for measuring their elasticity by determining the amount of bending which a plate of the crystal undergoes at the center when supported near its ends, under the influence of a weight applied at the center. By means of these highly elaborate instruments the author considers that he has raised the accuracy of goniometric measurements to the level on which atomic weight determinations now stand and the measurements of the physical constants of crystals to the degree of accuracy of wavelength determinations by the interference method.

The materials studied include some 54 salts in two series; the simple anhydrous sulphates and selenates of potassium, rubidium, caesium, ammonium and thallium, 10 in number; and the double hydrous sulphates and selenates of the above five elements with each of the metals magnesium, zinc, iron, nickel, cobalt, copper, manganese and cadmium, of which 44 were prepared. Many crops of crystals of each salt